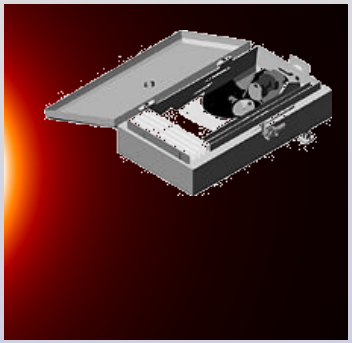


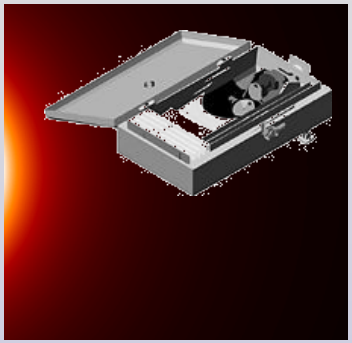
Heliospheric Imager – Scientific Operations

- HI Operations Document – R. Harrison
- HI Image Simulation – C. Davis & R. Harrison
- HI Operations Scenarios – R. Harrison & S. Matthews
- HI Beacon Mode Specification – S. Matthews

THE UNIVERSITY OF BIRMINGHAM

CCLRC Rutherford Appleton Laboratory

CSL



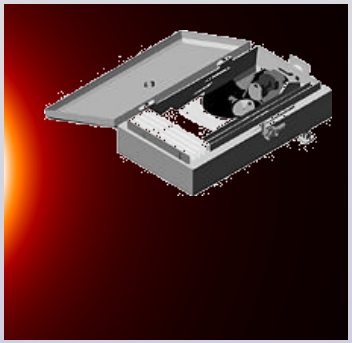
Heliospheric Imager – Scientific Operations

- HI in a nutshell:

First opportunity to observe Earth-directed CMEs along the Sun-Earth line in interplanetary space - the first instrument to detect CMEs in a field of view including the Earth!

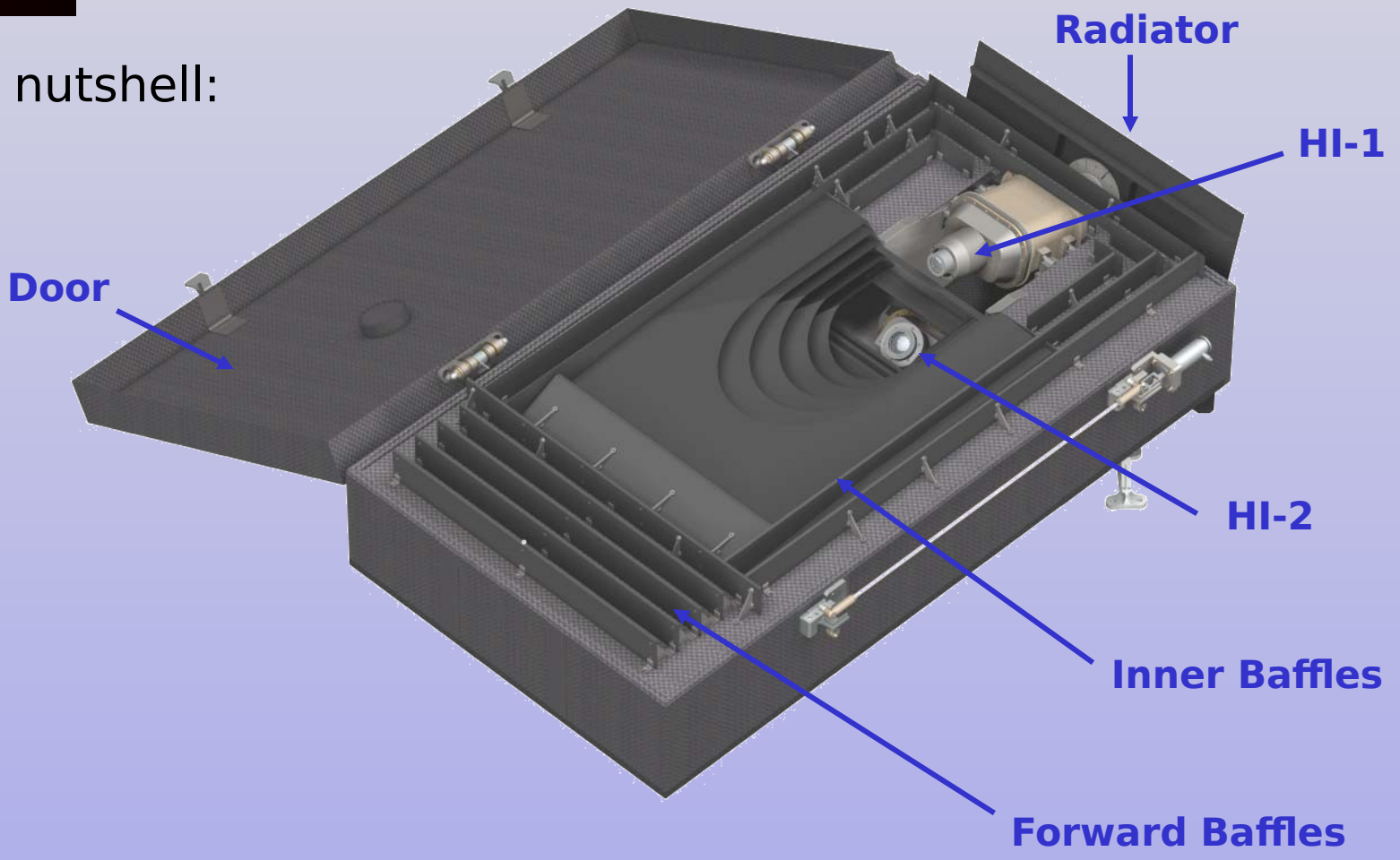
First opportunity to obtain stereographic views of CMEs in interplanetary space - to investigate CME structure, evolution and propagation.

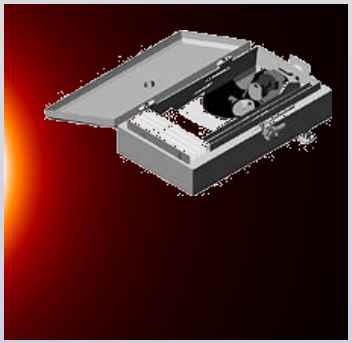
Method: Occultation and baffle system, with wide angle view of the heliosphere, achieving light rejection levels of $3x10^{-13}$ and 10^{-14} of the solar brightness.



Heliospheric Imager – Scientific Operations

- HI in a nutshell:

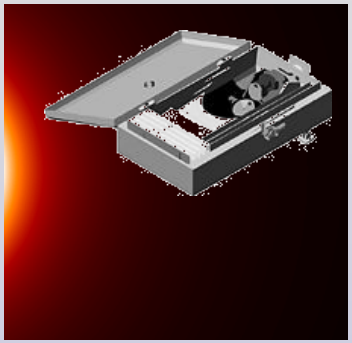




Heliospheric Imager – Scientific Operations

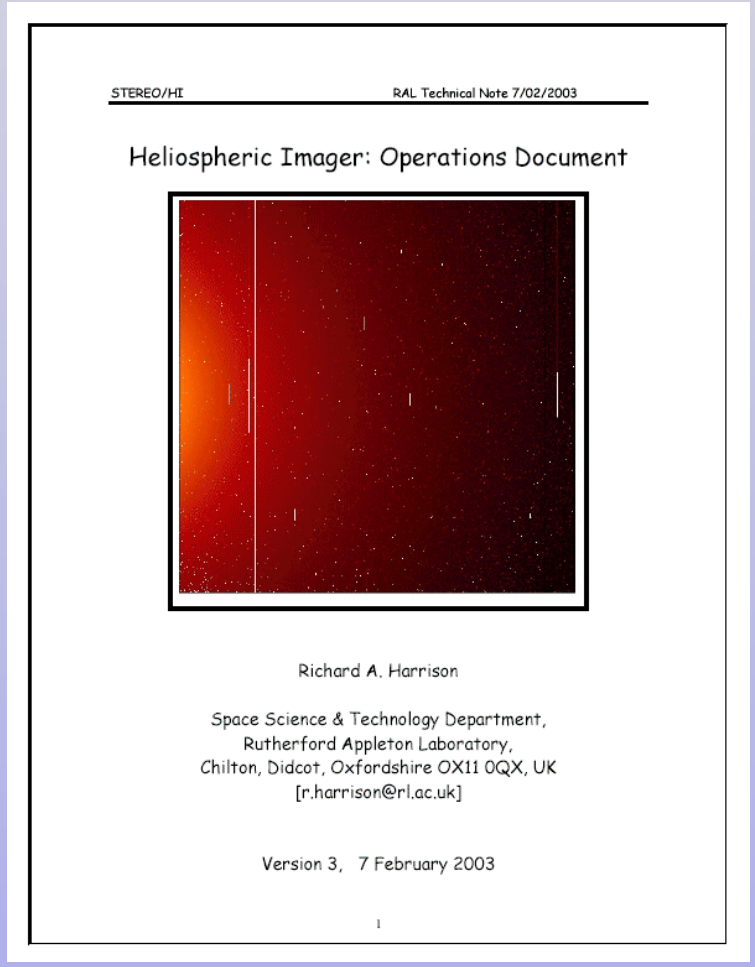
- HI in a nutshell:

	HI-1	HI-2
Instrument Type	Externally-Occulted Coronagraph	Externally-Occulted Coronagraph
Centre of Field-of-View Direction	Along Sun-Earth Line θ = 13.65 deg	Along Sun-Earth Line θ = 53.35 deg
Angular Field-of-View	20 deg	70 deg
Coronal Coverage	12 - 84 R_{sun}	66 - 318 R_{sun}
Overlap With COR2	12 - 15 R_{sun}	N/A
Overlap With HI-1	N/A	66 - 84 R_{sun}
Baseline Image (2 x 2 Binning)	1024 x 1024	1024 x 1024
Image Pixel Scale (Binned)	70 arcsec	4 arcmin
Spectral Bandpass	630 - 730 nm	400 - 1000 nm
Exposure Time	12 - 20 sec	60 - 90 sec
Nominal Images Per Sequence	70	50
Required Cadence (Per Sequence)	60 min	120 min
Brightness Sensitivity	3 x 10^{-15} B_{sun}	3 x 10^{-16} B_{sun}
Straylight Rejection	3 x 10^{-13} B_{sun}	10^{-14} B_{sun}
Brightness Accuracy	10%	10%



Heliospheric Imager – Scientific Operations

- HI Operations Document
  - HI Operations Document – Version 4 released Dec 1, 2003
  - Author: Richard Harrison, HI Principal Investigator
  - Document located at UK Web site: http://www.stereo.rl.ac.uk
  - The HI team is not aware of any other instrument operations document on STEREO.



STEREO/HI RAL Technical Note 7/02/2003

Heliospheric Imager: Operations Document

Richard A. Harrison

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Chilton, Didcot, Oxfordshire OX11 0QX, UK
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Version 3, 7 February 2003

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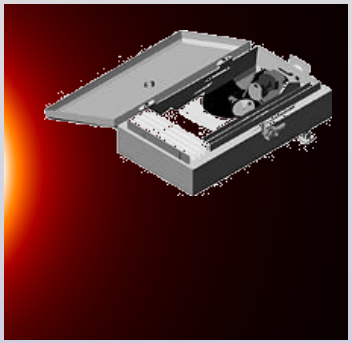
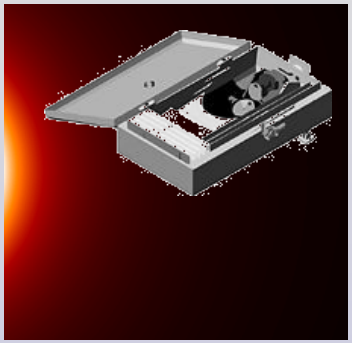


Heliospheric Imager – Scientific Operations

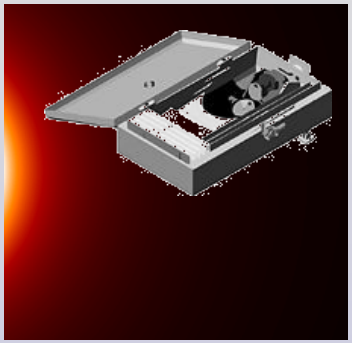
- HI Operations Document
  - Purpose: Sets out plans for the operation of the Heliospheric Imager. It is intended that this information be used as an input to the discussion on
    - the development of on-board and ground software (including planning tool software, archive software and data handling, inspection and analysis software),
    - payload operations planning,
    - commanding,
    - monitoring and data receipt,
    - data handling and archiving.

  In short – it spells out the requirements on operation and software.



Heliospheric Imager – Scientific Operations

- HI Operations Document – contents:
  - Operations planning and implementation
  - HI Scientific operation
  - Data monitoring and archiving
  - Image processing and calibration requirements
  - Instrument monitoring and maintenance
  - Commissioning plan
  - The beacon mode
  - Software requirements
  - Scientific operations sequences



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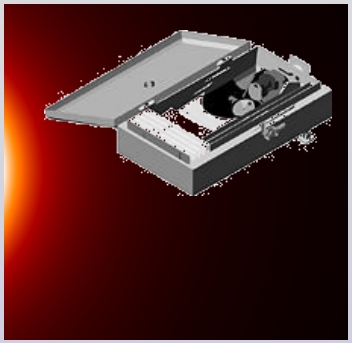
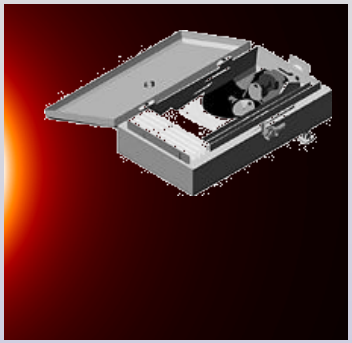


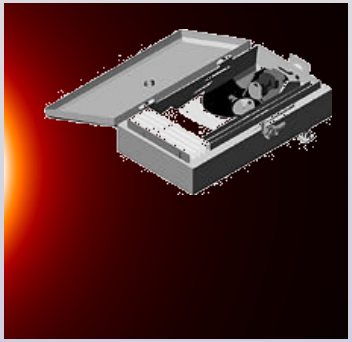
Heliospheric Imager – Scientific Operations

- HI Operations Document:
  - With regard to software and operations requirements, the HI Operations Document lists 34 requirements which must be considered by the SECCHI software team and those planning the operations facilities.
  - These requirements range from flexibility of programming parameters such as exposure times, to the return of partial frames, from cosmic ray cleaning to the definition of the beacon mode.



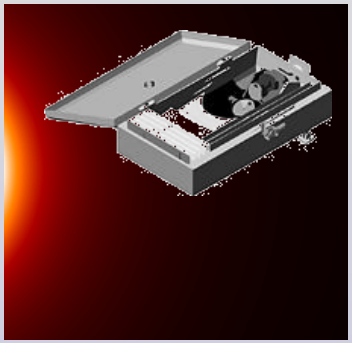
Heliospheric Imager – Scientific Operations

- HI Operations Scenarios:
  - With regard to HI Scientific Operations Sequences, we have continued the design of specific operations schemes, aimed at addressing specific scientific questions.
  - This is used to define the operation and its flexibility and comes out of the highly successful ‘Blue Book’ studies of CDS/SOHO.
  - The products are a clear understanding of how we wish to use the instrument, and clear definitions of the requirements on software and operations.
  - 15 scenarios so far – next slide…



Heliospheric Imager – Scientific Operations

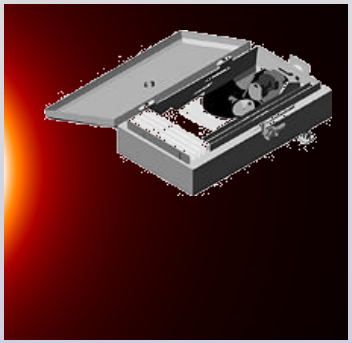
Study	***Author***
Synoptic CME programme	R. Harrison
Beacon mode	Matthews, Harrison, Davis
Impact of CME on Earth	R. Harrison
Understanding how observations at L1 & SECCHI are related	P. Cargill
CMEs in interplanetary space	P. Cargill
3-D structure of interplanetary CMEs	L. Green
CME onset	S. Matthews
Particle acceleration at CME shocks	S. Matthews
The relationship between CMEs and magnetic clouds	S. Matthews
Boundary regions between fast & slow streams in the solar wind	A. Breen
Development of co-rotating interaction regions	A. Breen
Solar wind microstructure	A. Breen
Differential drift velocities in the fast & slow solar winds	A. Breen
Remote solar wind measurements from 3-D obs. of cometary ion tails	G. Jones
Interplanetary acceleration of ICMEs	M. Owens



Heliospheric Imager – Scientific Operations

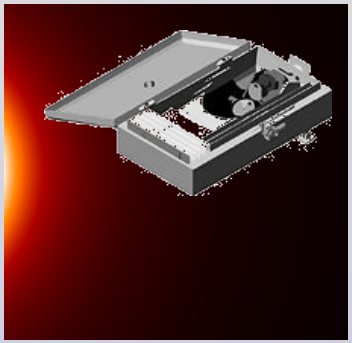
- HI Scientific Operations Scenarios – the Synoptic Mode:

	HI-1	HI-2
Image array	**1024x1024 (2kx2k summed)**	**1024x1024 (2kx2k summed)**
FOV	**20^0 (3.65-23.65)**	**70^0 (18.35-88.35)**
Nominal Exposure	**12 s**	**60 s**
Summed Exposures	**70**	**60**
Synoptic Cadence	**1 hr**	**2 hr**
Telemetry Rate	**2.9 kbit/s**	**1.5 kbit/s**



Heliospheric Imager – Scientific Operations

- The Beacon Mode –
  - Provided for quick data receipt, for space weather purposes
  - HI is a key player in this – the only instrument to see CMEs with Earth within the boundary of the FOV
  - Options:
    - Reduced resolution images;
    - N-S strip Sunward of Earth;
    - Partial images.



Heliospheric Imager – Scientific Operations

- The Beacon Mode –
  - Current plan:

Returned image 2048x2048	128x128 pixel image (summed from array on board)
Rate	1 image per hour, alternately HI-1 and HI-2.
Pixel depth	32 bits (defined by on board summed data)
Nominal telemetry	147 bit/sec.

Note: The beacon mode must be programmable so we can explore different approaches particularly in the early mission.